

Amendments to the Claims

Please amend the claims as instructed in the marked-up version of the Listing of the Claims presented below. This Listing of the Claims replaces all prior versions, and listings, of claims in the application.

Listing of the Claims

1. (Currently Amended) A control circuit for controlling a motor, the control circuit comprising:
 - a contactor circuit including a contactor and having first and second ends; and
 - a snubber circuit connected across the contactor circuit, the snubber circuit including
 - a first port electrically connected to the first end of the contactor circuit,
 - a second port electrically connected to the second end of the contactor circuit,
 - a first sub-circuit electrically connected to one of the first and second ports, the first sub-circuit including a resistor and a non-linear device electrically connected in parallel branches, ~~and~~
 - a second sub-circuit electrically connected in series with the first sub-circuit and to the other of the first and second ports, the second sub-circuit including an energy storage device and a second non-linear device, the energy storage device and the second non-linear device are electrically connected in parallel branches.
2. (Original) A control circuit as set forth in claim 1 wherein the non-linear device includes a diode.
3. (Original) A control circuit as set forth in claim 1 wherein the energy storage device includes a capacitor.
4. (Original) A control circuit as set forth in claim 1 wherein the snubber circuit receives a first current flowing from the first port through the first and second sub-circuits to the second port, and wherein a substantial portion of the first current flows through the non-linear device when the first current flows through the first sub-circuit.

5. (Original) A control circuit as set forth in claim 4 wherein the energy storage device charges when the first current flows through the second sub-circuit.

6. (Original) A control circuit as set forth in claim 5 wherein the energy storage device discharges when the contactor is closed, wherein the energy discharged from the energy storage device creates a second current that flows through the first sub-circuit opposite the first current, and wherein a substantial portion of the second current flows through the resistor when the second current flows through the first sub-circuit.

7. (Currently Amended) A control circuit ~~as set forth in claim 1~~ for controlling a motor, the control circuit comprising:

a contactor circuit including a contactor and having first and second ends;

a snubber circuit connected across the contactor circuit, the snubber circuit including

a first port electrically connected to the first end of the contactor circuit,

a second port electrically connected to the second end of the contactor circuit,

a first sub-circuit electrically connected to one of the first and second ports, the first sub-circuit including a resistor and a non-linear device electrically connected in parallel branches,

a second sub-circuit electrically connected in series with the first sub-circuit and to the other of the first and second ports, the second sub-circuit including an energy storage device; and

wherein the non-linear device is a first diode, wherein the second sub-circuit further includes a second non-linear device, and wherein the energy storage device and the second non-linear device are electrically connected in parallel branches.

8. (Original) A control circuit as set forth in claim 7 wherein the first and second non-linear devices each includes a diode, and wherein the energy storage device includes a capacitor.

9. (Original) A control circuit as set forth in claim 7 wherein the snubber circuit receives a first current flowing from the first port through the first and second sub-circuits to the second port, and wherein a substantial portion of the first current flows through the first non-linear device when the first current flows through the first sub-circuit.

10. (Original) A control circuit as set forth in claim 9 wherein the energy storage device charges when the first current flows through the second sub-circuit.

11. (Original) A control circuit as set forth in claim 10 wherein the energy storage device discharges when the contactor is closed, wherein the energy discharged from the energy storage device creates a second current that flows through the first sub-circuit opposite the first current, and wherein a substantial portion of the second current flows through the resistor when the second current flows through the first sub-circuit.

12. (Original) A control circuit as set forth in claim 9 wherein the snubber circuit receives a second current flowing from the second port through the first and second sub-circuits to the first port, and wherein a substantial portion of the second current flows through the second non-linear device when the second current flows through the second sub-circuit.

13. (Original) A control circuit for controlling a motor, the control circuit comprising:

- a contactor circuit including a contactor and having first and second ends; and
- a snubber circuit connected across the contactor circuit, the snubber circuit including
 - a first port electrically connected to the first end of the contactor circuit;
 - a second port electrically connected to the second end of the contactor circuit;
 - a first sub-circuit electrically connected to one of the first and second ports, the first sub-circuit including a resistor and a first non-linear device electrically connected in parallel branches; and
 - a second sub-circuit electrically connected in series with the first sub-circuit and to the other of the first and second ports, the second sub-circuit including a energy storage device and a second non-linear device electrically connected in parallel branches.

14. (Original) A control circuit as set forth in claim 13 wherein the snubber circuit receives a first current flowing from the first port through the first and second sub-circuits to the second port, wherein a substantial portion of the first current flows through the non-linear device when the first current flows through the first sub-circuit, and wherein the energy storage device charges when the first current flows through the second sub-circuit.

15. (Original) A control circuit as set forth in claim 14 wherein the energy storage device discharges when the contactor is closed, wherein the energy discharged from the energy storage device creates a second current that flows through the first sub-circuit opposite the first current, and wherein a substantial portion of the second current flows through the resistor when the second current flows through the first sub-circuit.

16. (Original) A control circuit as set forth in claim 15 wherein the first and second non-linear devices each includes a diode, and where the energy storage device includes a capacitor.

17. (Original) A control circuit for controlling a motor, the control circuit comprising:
- a contactor circuit including a contactor and having first and second ends; and
 - a snubber circuit connected across the contactor circuit, the snubber circuit including
 - a first port electrically connected to the first end of the contactor circuit and operable to receive a first current flow having a first direction,
 - a second port electrically connected to the second end of the contactor circuit and operable to receive a second current flow having a second direction opposite the first direction,
 - a first sub-circuit electrically connected to one of the first and second ports and including a resistor and a first diode electrically connected in circuit in parallel branches, the first diode being operable to allow a substantial portion of the first current to flow through the first diode when the first current flows through the first sub-circuit, and the resistor being operable to allow a substantial portion of the second current to flow through the resistor when the second current flows through the first sub-circuit, and
 - a second sub-circuit electrically connected in series with the first sub-circuit and to the other of the first and second ports, the second sub-circuit including a capacitor and a second diode electrically connected in circuit in parallel branches, the second diode being operable to allow a substantial portion of the second current to flow through the second diode when the second current flows through the first sub-circuit, and the capacitor charges when the first current flows through the second sub-circuit.

18. (Currently Amended) A vehicle comprising:
- a motor; and
 - a control circuit operable to control the motor, the control circuit including a contactor circuit having a contactor, a first end and a second end, and a snubber circuit connected across the contactor circuit, the snubber circuit including
 - a first port electrically connected to the first end of the contactor circuit,
 - a second port electrically connected to the second end of the contactor circuit,
 - a first sub-circuit electrically connected to one of the first and second ports, the first sub-circuit including a resistor and a non-linear device electrically connected in parallel branches, ~~and~~
 - a second sub-circuit electrically connected in series with the first sub-circuit and to the other of the first and second ports, the second sub-circuit including an energy storage device and a second non-linear device electrically connected in parallel branches.
19. (Original) A vehicle as set forth in claim 18 wherein the non-linear device includes a diode.
20. (Original) A vehicle as set forth in claim 18 wherein the energy storage device includes a capacitor.
21. (Original) A vehicle as set forth in claim 18 wherein the snubber circuit receives a first current flowing from the first port through the first and second sub-circuits to the second port, and wherein a substantial portion of the first current flows through the non-linear device when the first current flows through the first sub-circuit.
22. (Original) A vehicle as set forth in claim 21 wherein the energy storage device charges when the first current flows through the second sub-circuit.

23. (Original) A vehicle as set forth in claim 22 wherein the energy storage device discharges when the contactor is closed, wherein the energy discharged from the energy storage device creates a second current that flows through the first sub-circuit opposite the first current, and wherein a substantial portion of the second current flows through the resistor when the second current flows through the first sub-circuit.

24. (Currently Amended) A vehicle ~~as set forth in claim 18~~ comprising:

a motor; and

a control circuit operable to control the motor, the control circuit including a contactor circuit having a contactor, a first end and a second end, and a snubber circuit connected across the contactor circuit, the snubber circuit including

a first port electrically connected to the first end of the contactor circuit,

a second port electrically connected to the second end of the contactor circuit,

a first sub-circuit electrically connected to one of the first and second ports, the first sub-circuit including a resistor and a non-linear device electrically connected in parallel branches, and

a second sub-circuit electrically connected in series with the first sub-circuit and to the other of the first and second ports, the second sub-circuit including an energy storage device; and

wherein the non-linear device is a first diode, wherein the second sub-circuit further includes a second non-linear device, and wherein the energy storage device and the second non-linear device are electrically connected in parallel branches.

25. (Original) A vehicle as set forth in claim 24 wherein the first and second non-linear devices each includes a diode, and wherein the energy storage device includes a capacitor.

26. (Original) A vehicle as set forth in claim 24 wherein the snubber circuit receives a first current flowing from the first port through the first and second sub-circuits to the second port, and wherein a substantial portion of the first current flows through the first non-linear device when the first current flows through the first sub-circuit.

27. (Original) A vehicle as set forth in claim 26 wherein the energy storage device charges when the first current flows through the second sub-circuit.

28. (Original) A vehicle as set forth in claim 27 wherein the energy storage device discharges when the contactor is closed, wherein the energy discharged from the energy storage device creates a second current that flows through the first sub-circuit opposite the first current, and wherein the a substantial portion of the second current flows through the resistor when the second current flows through the first sub-circuit.

29. (Original) A vehicle comprising:

a motor; and

a control circuit operable to control the motor, the control circuit including a contactor circuit having a contactor, a first end and a second end, and a snubber circuit connected across the contactor circuit, the snubber circuit including

a first port electrically connected to the first end of the contactor circuit;

a second port electrically connected to the second end of the contactor circuit;

a first sub-circuit electrically connected to one of the first and second ports, the first sub-circuit including a resistor and a first non-linear device electrically connected in parallel branches; and

a second sub-circuit electrically connected in series with the first sub-circuit and to the other of the first and second ports, the second sub-circuit including a energy storage device and a second non-linear device electrically connected in parallel branches.

30. (Original) A vehicle as set forth in claim 29 wherein the snubber circuit receives a first current flowing from the first port through the first and second sub-circuits to the second port, wherein a substantial portion of the first current flows through the non-linear device when the first current flows through the first sub-circuit, and wherein the energy storage device charges when the first current flows through the second sub-circuit.

31. (Original) A vehicle as set forth in claim 29 wherein the energy storage device discharges when the contactor is closed, wherein the energy discharged from the energy storage device creates a second current that flows through the first sub-circuit opposite the first current, and wherein a substantial portion of the second current flows through the resistor when the second current flows through the first sub-circuit.

32. (Original) A vehicle as set forth in claim 30 wherein the first and second non-linear devices each includes a diode, and where the energy storage device includes a capacitor.

33. (Currently Amended) A method of suppressing arcing in a contactor circuit including a contactor having at least two contacts that make and break an electrical connection, the method comprising the acts of:

providing a snubber circuit including a first sub-circuit and a second sub-circuit electrically connected in series, the first sub-circuit including a first branch having a resistor and a second branch having a first non-linear device, and the second sub-circuit ~~including~~ having a third branch having a second non-linear device and a fourth branch having a storage device;

electrically connecting the first sub-circuit to one end of the contactor circuit;

electrically connecting the second sub-circuit to the other end of the contactor circuit;

breaking the electrical connection of the contacts;

generating a first current in response to the breaking of the electrical connection;

allowing a substantial portion of the first current to flow through the non-linear device;

and

charging the energy storage device with energy of the first current.

34. (Original) A method as set forth in claim 33 and further comprising the acts of:

after the charging act, making the electrical connection of the contacts;

generating a second current in response to the making of the electrical connection, the second current flowing in an opposite direction of the first current; and

allowing a substantial portion of the second current to flow through the resistor.

35. (Original) A method as set forth in claim 33 wherein the non-linear device includes a diode.

36. (Original) A method as set forth in claim 33 wherein the storage device includes a capacitor.

37. (Currently Amended) A method ~~as set forth in claim 33~~ of suppressing arcing in a contactor circuit including a contactor having at least two contacts that make and break an electrical connection, the method comprising the acts of:

providing a snubber circuit including a first sub-circuit and a second sub-circuit electrically connected in series, the first sub-circuit including a first branch having a resistor and a second branch having a non-linear device, and the second sub-circuit including a storage device;

electrically connecting the first sub-circuit to one end of the contactor circuit;

electrically connecting the second sub-circuit to the other end of the contactor circuit;

breaking the electrical connection of the contacts;

generating a first current in response to the breaking of the electrical connection;

allowing a substantial portion of the first current to flow through the non-linear device;

and

charging the energy storage device with energy of the first current; and

wherein the non-linear device is a first non-linear device, and wherein the second sub-circuit further includes a third branch having a second non-linear device and a fourth branch having the storage device ~~capacitor~~.

38. (Original) A method as set forth in claim 37 and further comprising the acts of:

breaking the electrical connection of the contacts a second time;

generating a second current in an opposite direction of the first current in response to the breaking of the electrical connection the second time;

allowing a substantial portion of the second current to flow through the second non-linear device; and

allowing a substantial portion of the second current to flow through the resistor.

39. (Original) A method as set forth in claim 38 wherein the storage device includes a capacitor.

40. (Original) A method as set forth in claim 38 wherein the first and second non-linear devices include a first and second diode, respectively.